Thesis/
Reports
Wieslander,
A. E.

SOIL-VEGETATION SURVEYS
THEIR VALUE AND USE IN WILD LAND MANAGEMENT

By

A. E. Wieslander and John L. Retzer

California Forest and Range Experiment Station

National FS Library
USDA [illegible]
APR 29 2009
[illegible]
Fort Collins CO 80526

INTRODUCTION

Managers of wild lands deal with trees, shrubs, and herbaceous plants which are crops of the soil. In reality soil is the most important factor dealt with. Land managers harvest the productivity of the soil in the form of timber, forage, and other products. Soils are not all equally productive nor do they produce the same crop equally well. The land manager, therefore, must be cognizant of productivity potentials of soils for different uses. He also must recognize erodibility hazards resulting from kinds and intensities of use and the need to conduct operations so as not to destroy the productivity of the soil but rather to increase it when possible.

Realistic land use planning must be based upon knowledge of both soils and native vegetation. This is obtained from soil-vegetation surveys that combine the mapping of soils and associated vegetation in one operation. From such surveys the land planner obtains (1) accurate information on the kinds of soils and plants and their characteristics, (2) their location or distribution in an area, (3) the quantity of each in terms of acres, and (4) information on the interrelationships between plants and soils. It should be understood that soil-vegetation surveys supply basic data on soils and vegetation. From this information interpretations for use are made. These interpretations are based upon (1) field observations and measurements, (2) experience of land managers in using different kinds of land, and (3) results of experiments of the forest and range experiment stations. Interpretations will change or become more precise as more information becomes available; the basic data of the soil-vegetation surveys will not change.

There is a growing recognition by land planners of the need for soils information. Formerly surveys by the Department of Agriculture and State agricultural experiment stations were made only on cultivated or potentially tillable lands. This is now changing in many states. Region 5 of the Forest Service pioneered with surveys of wild lands and their example will be followed, with modifications, in other regions. Other Government agencies such as the Bureau of Land Management and Indian Service now have and use soil surveys or soils information in their land planning. Gardner and Lyford [1/] summarized progress made in wild land surveys up to 1954.

[1/] Gardner, Robert A. and W. H. Lyford. Status and Needs for Soil Survey in Forested Land. Soil Science Soc. Amer. Proc. 19:91 (1955).

They reported that within the last five years the following estimated acreage of forest and wild lands had been mapped:

Eastern and Southern States

- Detailed Soil Surveys--8.2 million acres
- Reconnaissance Soil Surveys--5.6 million acres

Western States

- Detailed Soil Surveys--2.6 million acres
- Reconnaissance Soil Surveys--2.2 million acres
- Soil-Vegetation Surveys--3.5 million acres

The trend is further emphasized by the increasing numbers of soil scientists appearing on the staffs of the forest and range experiment stations and in the regional offices of the Forest Service.

In California, soil-vegetation surveys are moving forward at the rate of about one million acres a year and pressures are developing for speeding up the program. Begun in 1947, they now cover more than 4.5 million acres. This acreage includes some 800,000 acres of national forest lands, and scheduled cooperative surveys will add about 250,000 acres each year. Besides these area surveys, spot investigations are being made in connection with road construction projects or at locations under consideration for tree planting or seeding to forage plants. Many of these spot investigations pertain to brush conversion projects. Region 2 and 3 have similar spot surveys. The information is used in land treatment and small watershed programs and will be expanded for use in overall land use planning of ranger districts in the future.

This paper is to inform the conference about soil-vegetation surveys which are providing the national forests in California with a substantial amount of the basic information needed to do a better job of planning and multiple-use management. We feel that this kind of survey, with needed modifications, will have application to national forest lands in other regions.

KINDS OF DATA OBTAINED

Vegetation and soils information from these surveys is more detailed than any yet gathered for large areas of wild lands. Significantly different kinds of vegetation and soils are mapped to a minimum area of 10 acres; the less significantly different kinds to 40 acres.

Vegetation -- Types of woody vegetation are classified according to dominant species composition, age and density of timber stands, and total density of the combined tree and shrub cover. Species composition of former conifer timber stands is estimated and shown in areas where logging, burning, or land clearing has changed the type. Whether or not the tree or shrub species are killed by fire or sprout after fire, is determined.

Soils -- The soils are classified according to the basic nationwide system. First separated by soil series, they are subdivided into soil phases on the basis of classes of depth, steepness of slope, erosion, rockiness, coarse fragments, and parent rock of possible hydrological or other significance. The soil series differentiates kinds of soil on the basis of distinctive natural combinations of a number of physical, chemical, and morphological characteristics and on the type of parent material or parent rock. The soil phases are mapped because of their bearing on land uses not otherwise expressed by the soil series. Areas of severe erosion too small to delineate are recorded on the maps by symbols. Samples of the soils mapped are analyzed for chemical and physical properties and standard greenhouse tests are made to determine fertility status.

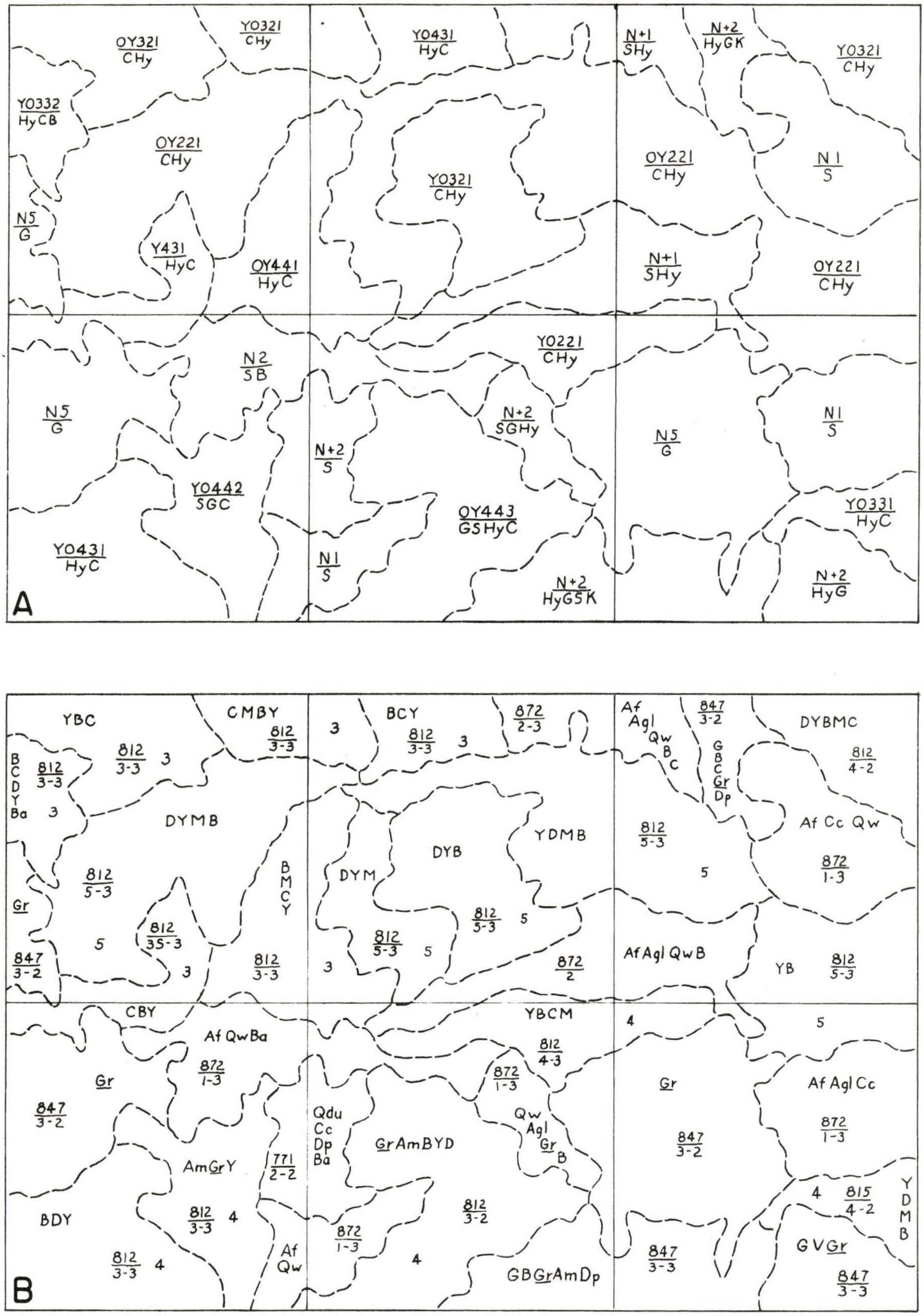

OY321/CHy
Y0321/CHy
Y0431/HyC
N+1/SHy
N+2/HyGK
Y0321/CHy
Y0332/HyCB
OY221/CHy
Y0321/CHy
OY221/CHy
N1/S
N5/G
Y431/HyC
OY441/HyC
N+1/SHy
OY221/CHy
Y0221/CHy
N2/SB
N5/G
N+2/SGHy
N5/G
N1/S
N+2/S
Y0442/SGC
OY443/GSHyC
Y0331/HyC
Y0431/HyC
N1/S
N+2/HyGSK
N+2/HyG
A
YBC
CMBY
812/3-3
3
BCY
812/3-3
3
872/2-3
Af Agl Qw B C
847/3-2
G B C Gr Dp
DYBMC
B C D Y Ba
812/3-3
812/3-3
3
3
812/4-2
DYMB
DYB
YDMB
812/5-3
Af Cc Qw
BMCY
DYM
5
872/1-3
812/5-3
Gr
812/35-3
812/5-3
5
5
812/5-3
5
847/3-2
3
812/3-3
3
872/2
AfAglQwB
YB
812/5-3
CBY
YBCM
4
5
AfQwBa
812/4-3
Gr
872/1-3
872/1-3
Gr
Af Agl Cc
847/3-2
Qdu Cc Dp Ba
GrAmBYD
Qw Agl Gr B
847/3-2
872/1-3
AmGrY
771/2-2
4
815/4-2
YDMB
BDY
812/3-3
4
812/3-2
872/1-3
Af Qw
4
847/3-3
GVGr
812/3-3
4
GBGrAmDp
847/3-3
B

Figure 1

A. Section of a Timber Stand - Vegetation Cover map.

B. Corresponding section of a Soil - Vegetation map.

LEGEND FOR FIGURE 1A

AGE STRUCTURE OF TIMBER
- O - Old Growth
- OY - Old Growth-Young Growth
- YO - Young Growth-Old Growth
- Y - Young Growth

NONTIMBER LANDS
- N+ with tree stands on gentle terrain
- N- with tree stands on rugged terrain
- N without tree stands

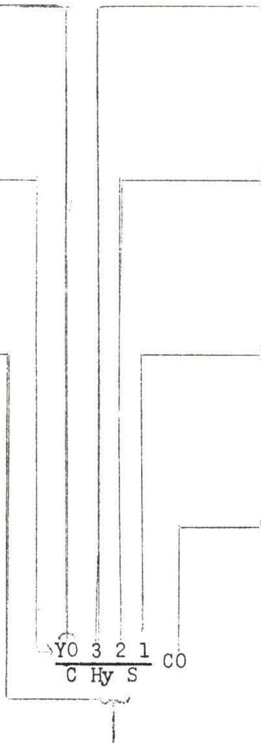
AGE STRUCTURE OF "H"
- O Old Growth
- y Young Growth

DENSITY OF SAWLOG TIMBER
- 1 - Dense
- 2 - Semidense
- 3 - Open
- 4 - Very Open
- 5 - Extremely Open or None

DENSITY OF ALL TIMBER
- 1 - Dense
- 2 - Semidense
- 3 - Open
- 4 - Very Open
- 5 - Extremely Open or None

DENSITY OF TOTAL WOODY VEGETATION
- 1 - Dense
- 2 - Semidense
- 3 - Open
- 4 - Very Open
- 5 - Extremely Open or None

This area has been obviously cut over in recent years.



VEGETATION COVER AND OTHER ELEMENTS

- C - Commercial Conifers
- K - Minor Conifers
- H - Hardwoods
- S - Shrubs
- F - Bushy Herbs

- G - Grass
- M - Marsh
- B - Bare Ground
- R - Rock
- A - Cultivated
- U - Urban Industrial

LEGEND FOR FIGURE 1B

VEGETATION

B	California black oak
C	Canyon oak
D	Douglas-fir
G	Oregon white oak
Dp	Digger pine
M	Pacific madrone
V	Valley oak
Af	Chamise
Agl	Eastwood manzanita
Am	Common manzanita
Cc	Wedgeleaf ceanothus
Qdu	Leather oak
Qw	Scrub interior live oak
Gr	Grass and associated herbaceous species
Ba	Bare ground without vegetation

SOILS

Series → 812

Depth class → 4-2 ← Slope class

Series

771 Henneke, 812 Hugo, 815 Josephine, 847 Laughlin, 872 Maymen

Depth Classes

1 (0 - 1 ft.), 2 (1 - 2 ft.), 3 (2 - 3 ft.), 4 (3 - 4 ft.), 5 over 4 ft.

Slope Classes

1 (less than 30%), 2 (30 - 50%), 3 (50 - 70%)

TIMBER SITE INDEX CLASSES

3 S.I. 125 (low), 4 S.I. 150 (medium), 5 S.I. 175 (high)

Information obtained by the soil-vegetation survey is made available on maps and as tabular material and in reports. The maps include (1) uncolored quadrangle sheets at a scale of 2 inches to the mile, including sheets for timber stand-vegetation cover and for soil-vegetation as illustrated in Figure 1, and (2) a more generalized colored county map of the upland soils at a scale of 1/2 inch to the mile. The tabular material accompanying each quadrangle sheet provides, for each tree and shrub species mapped, information on its sprouting nature and its browse value; for the different soils mapped, information on permeability, general drainage, erosion hazard, range in mean annual precipitation, estimated suitability for timber production, and estimated suitability for extensive range use. Reports prepared for county or other large areas will include discussions of individual soil series and their phases with particular emphasis on normally associated vegetation, characteristics of significance in use or management of the soils, and suitability of the soils for particular uses. The reports will also include statistical tables showing acreage breakdowns of soils in relation to associated vegetation, laboratory and greenhouse data, and tables listing important characteristics and attributes of soils.

USES OF SOIL-VEGETATION DATA

The kind of soil, the normally associated kind of native vegetation, and the estimated suitability class of the soil for timber and forage production help Forest Service land managers decide on the best use of the soil in the public interest.

The suitability classes suggest alternative uses of land and indicate the possibility of success of those alternative uses. Suitability classes resulting from the basic data of soil-vegetation surveys do not mean that the land manager must change current use. But if he desires to do so, the best possible alternative uses are suggested.

Soils can be grouped on the basis of normally associated vegetation and general suitability for broad uses into three major groups, as illustrated on the attached map of the upland soils of Lake County.

Group 1 soils, shown in green, are normally associated with conifer timber. These soils are in general those best suited for timber production and are of relatively low value for range forage production. Group 2 soils, shown in orange, are normally associated with grass and oak trees of non-timber value. These soils in general are those best suited for range forage production and unsuited for timber production.

Group 3, shown in brown, are normally associated with chaparral vegetation. These soils are in general the least suited for range forage production and of no value for timber production. However, the chaparral vegetation provides a habitat for deer and other wildlife. The more specific uses of the soil-vegetation data will be discussed as they relate to the management of these three groups of soils.

USES IN MANAGEMENT OF GROUP 1 SOILS

National forest land comprising Group 1 soils will be managed primarily for yield of timber and water. Watershed management will be accomplished mainly through protection of the vegetative cover from fire and other damage and through control of timber management practices.

Fire Protection -- Survey information on kind, age, and density of timber stands and on kind of soil, steepness of slope, and erosion characteristics of the soils can be interpreted in terms of fuel types and damaging effects of fire to growing stock and to soil stability and productivity. This in turn will aid in planning better fire protection and control. The water manager will want a higher degree of protection given the steep slopes of the Siskiyou soils where the hazard of overland waterflow and erosion is high, than to the moderate slopes of Olympic soils where the hazard is relatively low.

Timber Management Plans -- Region 5 is using the survey information effectively in preparing timber management plans. The required area inventory of timber types and age, stocking, and site classes are provided by the 2-inch scale quadrangle maps. These maps in turn are used to lay out a system of sample plots to obtain the required timber volume and growth inventory.

Access and Protection Roads -- Region 5 road engineers are finding the soil-vegetation survey information of value in locating and designing timber access and protection roads. Vegetation data are valuable in showing (1) the location and extent of merchantable stands which must be tapped by the road system; (2) the nature of the vegetation that must be cleared; and (3) the character of the cover protecting the slopes above and below the road.

Knowledge of the soils and their characteristics help the engineer to make the best location. When possible, he will avoid soils with sheer zones and those with clay textures. Laboratory tests on soil samples together with field observations provide the engineer with guides to surfacing, drainage, slope, and grade requirements. These guides have been developed for many of the dominant soils mapped. The resulting better road location and engineering is of significance to the water manager. It should reduce to a minimum the adverse effects that road building can have upon erosion, overland flow during storms, and quality of streamflow.

Timber Cutting Methods -- The timber manager can use the information on kinds and conditions of timber stands and kinds of soil to apply cutting methods appropriate to specific situations. For example: On the character of the stand alone, a moderately heavy selection cutting is indicated in similar mature stands on Olympic and Holland soils, but erodibility of the soils modifies this suggestion. On the erosion-resistant Olympic soils, the heavy cut will result in the highest wood production. But on the highly erodible Holland soils, it would not be advisable in the long run; to prevent erosion and consequent site deterioration, a lighter cut should be made.

The water manager can likewise use this survey information to apply cutting methods appropriate to specific situations. This may be especially significant in the snow pack zone where he hopes for research findings that can be translated into cutting practices to increase the water yield. Possibly, such findings applied to the stand on the Olympic soils in the above example would result in a still heavier cut which could be safely made.

However, these findings could not be applied to the highly erodible Holland soils where disastrous effects of overland flow and erosion and timber site deterioration would far outweigh any water to be gained from reduced evaporation-transpiration.

Reforestation -- For areas needing planting, the survey provides information on the kind, density, and sprouting nature of the non-timber vegetation, the degree of productivity of the soil, and the kind of timber species the soil has successfully grown in the past. This information will aid the timber manager to select for planting the most productive sites and those least costly to prepare for planting. It will prevent him from planting the wrong tree for the climate and soil. The information will aid the water manager who will be particularly concerned with site preparation for planting. On the more erodible soils, he may restrict the use of heavy mechanical brush clearing equipment or require contour clearing along relatively narrow lanes.

Post-Logging Soil Stabilization -- The survey information on kind of soil and its erosion hazard, together with field observations of logged areas in relation to soil and steepness of slope, will be of value to both the water and timber managers in planning appropriate engineering measures to keep overland flow, erosion, and site deterioration to a minimum. Very little may need to be done on soils that are erosion-resistant; very much on those that are high erodible. For example, in the course of mapping two soils series, Olympic and Forward in Tehama County, portions of both having been logged over, a field mapper recorded the following in his notes:

> "Erosion hazard of Olympic soils is low. An occasional gully may occur on poorly drained logging roads. These soils in general present no particular flood or erosion problem. The Forward soils present more of a problem. Considerable soil movement occurs on bare surfaces. Abandoned roads and trails are particularly susceptible to gully erosion."

USES IN MANAGEMENT OF GROUP 2 AND 3 SOILS

Group 2 soils will be managed primarily for range forage and yield of water. Water management will be accomplished mainly in connection with the protection and maintenance of vegetation cover and its management for range purposes.

Group 3 soils because they are generally unsuitable for timber production and of low or very low suitability for range forage, will be managed primarily as watersheds and habitat for deer or other game. Water management will be accomplished primarily through protection and maintenance of a protective vegetative cover and manipulation of the vegetation to improve browse and other forage for deer.

Details for specific uses as in Group 1 soils above are omitted here for the sake of brevity.

MORE ABOUT USES IN WATERSHED MANAGEMENT

How soil-vegetation information helps in planning for watershed management is illustrated by summary hydrological interpretations that Rowe and Colman [1] have made of three dominant upland soils. These soils, Josephine, Laughlin, and Maymen, are representative of soil Groups 1, 2, and 3. Their interpretations are quoted as follows:

> "The hydrological properties of the Josephine soil and the vegetative cover associated with it, adapt it well to timber management as a means for working for waterflow control. However, owing to the steep slopes and the soil's erodibility when unprotected by vegetation, protection against fire is required and care must be

---

[1] Rowe, P. B. and Colman, E. A. Uses of soil-vegetation survey information in watershed management. Presented before Division V-A, Soil Science Society of America, Davis, California, August 18, 1955.

exercised in logging and road building to prevent erosion from becoming serious.

"Land management to control floods and erosion is usually the most important function of watershed management on areas of Laughlin soil. If heavily grazed and trampled, or denuded by fire, the permeability of the surface soil is sometimes reduced markedly, resulting in increased runoff and erosion rates. Because infiltration and soil stability are so subject to impairment under land use, surface soil protection is imperative in any land treatment designed to increase the yield of water.

"In general, Maymen soil is unsuited for timber production or grazing because it will support only poor tree and grass growth. Therefore, management consists principally of protecting or improving existing vegetation cover, or revegetation of damaged watersheds. In some areas, supplemental mechanical controls are needed to regulate streamflow and reduce slope and channel erosion."

We will conclude this discussion of uses of soil-vegetation data with the following statement by Rowe and Colman:

"It appears that the hydrological properties of the soil and the substratum and the management opportunities exhibited by the associated vegetation must be known for adequate planning of watershed management. A type of survey that includes both is obviously to be desired."

LIMITATIONS OF SOIL-VEGETATION DATA IN LAND MANAGEMENT

Soil-vegetation survey information does not supply all the answers to land management problems because there are many other factors involved. For example: Rowe and Colman point out that in watershed management not only is basic soil-vegetation data needed but also information on the amount, character, distribution, and intensity of precipitation; the size and shape of drainage areas; and length, character, and distribution of stream channels. They also point out the need for more quantitative data on hydrologic properties than are now provided by soil-vegetation surveys. In every field of land management the value of the soil information from the survey is limited because there is much yet to be learned through experience and research about the behavior characteristics of wild land soils. Without a soil-vegetation survey it is difficult to extend the results of research and experience in timber, range, and watershed management to other wild land areas.

COSTS

Soil-vegetation surveys at the intensity carried on in California are costing around 10 cents an acre exclusive of photo-flying costs. Of this, about 8 cents covers aerial photo interpretation and field mapping of both soil and vegetation; 2 cents covers map compilation and publication. These surveys are locally considered well worth this cost. For example, they save many times their cost in preventing costly expenditures of $5 to $20 or more per acre in brush eradication and seeding on unsuited soils. Also, surveys direct costly tree planting of $45 or more per acre to the more productive soils.

WHO SHOULD DO THE JOB?

The question has been raised as to who should do the job on the national forests. If the job was entirely a soil survey, it would be logical to ask why not have the Soil Conservation Service do the work since that agency is responsible for the soil surveys in the Department of Agriculture. But because the work is in wild land, the soil-vegetation surveys combine the mapping of soil and vegetation in one operation, it seems appropriate for the Forest Service to do the job. In California, the work began by adding soil mapping to a going Forest Service project of mapping timber and other vegetative types. This proved to be an advantageous and economical way to get accurate soils information which in turn proved to be more readily useful because related to kind and condition of the vegetative cover. Moreover, the California experience, working in cooperation with the soil survey of the University of California, is (1) that this combined soil and vegetation mapping takes an additional kind of training than is now possessed by most soil scientists, as well as an additional kind of training for foresters, and (2) that training for this work and also the work itself is best accomplished by foresters and soil scientists working together.

Since the soils are mapped according to the national system of classification, correlation contact is maintained with the Soil Conservation Service. Also, this agency is making use of soil-vegetation data. It has directly participated with the Forest Service in soil-vegetation surveys of national forest lands within Soil Conservation Districts. In one county, anticipating the possibility of getting a State-financed soil-vegetation survey of the upland areas, the Soil Conservation Service is largely restricting its current soil surveys to valley areas in order to avoid duplication of effort.

Thus, we definitely feel that the Forest Service should continue to do the job in California. It is possible that conditions existing in other regions may make some other approach desirable and feasible. The important thing to remember is that a basic soil-vegetation survey does collect and present accurate, definite data relevant to the long-time needs of the Forest Service in its land management job.

CONCLUSIONS AND RECOMMENDATIONS

The multipurpose management of national forest lands for yields of timber, forage, and water involves protection and maintenance and the growing and harvesting of trees, shrubs, and herbaceous plants which are crops of the soil. Intensive management of national forest lands, therefore, dictates the need for basic facts on both vegetation and soil. With management of national forests rapidly shifting from custodianship to more intensive land use practices, it is becoming increasingly important that such facts be obtained. Soil-vegetation surveys developed by the Forest Service and cooperating agencies are now getting such basic information for a substantial area of wild land in California, but three times as fast on private land as on national forest land. The survey information where available is finding uses in management of national forest lands but only a start has been made. Other regions have likewise covered limited areas with varying approaches. If the Forest Service is to maintain a position of leadership in wild land management, it should take steps to further improve soil-vegetation surveys, increase the program in California, and extend such surveys to national forests in other regions.

We therefore recommend:

1. That the data from the soil-vegetation pilot study of the Morena Reservoir area in the Cleveland National Forest now being completed, be studied and evaluated by research and aministration with the objective of:

    (a) Putting the data to full use in management of the Morena watershed, for maximum yield of water and prevention of siltation of the reservoir.

    (b) Improving soil-vegetation surveys for watershed management and other uses locally and elsewhere.

2. That soil-vegetation surveys be made for pilot study areas of 100 square miles or more in other Forest Service regions with the objective of:

    (a) Adapting soil-vegetation survey methods to regional situations.

    (b) Interpreting and putting the data to full use in the management of the pilot study areas.

(c) Providing the basis for extending the survey and using the information in national forest areas of the different regions.

3. That a training school be held on a suitable national forest for the men who will be responsible for and conduct the pilot study surveys under (2) above.

4. That ways and means be found for providing more adequate financing to speed up the soils-vegetation survey work. Since all functions will derive benefit from availability of this basic data, the cost of the work should be shared by all functions.

A SUPPLEMENT TO THE MAP

OF

UPLAND SOILS OF LAKE COUNTY

The attached tables have been prepared to accompany the map entitled UPLAND SOILS OF LAKE COUNTY, 1955. They show some of the characteristics of the soils mapped and the estimated suitabilities of the soils for timber production and extensive range use. The data presented in the tables are preliminary and subject to revision in a more detailed report now in preparation, but in the meantime should be helpful to land owners and others in using the map.

September 1955

State of California
Department of Natural Resources
Division of Forestry

In cooperation with

University of California

And

U. S. Department of Agriculture--Forest Service
California Forest and Range Experiment Station
Cooperative Soil-Vegetation Survey Project

Legend for soils shown on the map of UPLAND SOILS OF LAKE COUNTY
with a partial tabulation of soil characteristics and estimated
suitabilities for timber production and extensive range use1/

SOILS NORMALLY ASSOCIATED WITH CONIFER TIMBER (DOUGLAS-FIR, PINE AND FIR) -- Green color on map

Soil series symbol 2/	Soil series name	Parent material 3/	General drainage 4/	Erosion hazard 5/	Mean 6/ annual precipitation	Soil 7/ depth & other phases	Estimated suitabilities for: Timber production 8/	Extensive range use 9/
711	Aiken	Basaltic rock	Good	Moderate	30-60	4	Medium	Medium
						5	High	Medium
712	Butte	Rhyolitic rock	Good	High	40-70	3	Low to medium	Medium to low
						4	Medium to high	Medium
						5	High	Medium
715	Salminas	Andesitic rock	Good	Moderate	30-70	3	Medium to low	Medium
						4	Medium to high	Medium
						4R	Medium	Medium
						5	High	Medium
717	Olympic	Andesitic or basaltic rock	Good	Moderate	55-60	5	Very high	Medium
723	Comptche	Metamorphosed igneous rock	Good	Moderate	50-55	4	Medium	Medium
726	Dubakella	Serpentine	Good	Moderate	50-55	2,3	Low	Low
727	Glenview	Obsidian & related volcanic rock	Good	Slight	40-50	3	Low	Low
						4	Medium	Low
728	Neuns	Metamorphosed igneous rock	Good	Moderate	45-55	3,4	Low	Low
799	Hohmann	Metamorphosed igneous rock	Good to excessive	Moderate	50-55	3	Low to medium	Medium to low
						3R,3S	Low	Low
						4	Medium to high	Medium to low
7118	Boomer	Basic igneous rock	Good to excessive	Moderate	45-55	3	Low to medium	Medium to low
						4	Medium to high	Medium to low
812	Hugo	Sandstone and shale	Good	Moderate	35-70	3	Medium to low	Medium to low
						4	High to medium	Medium
						5	High to very high	Medium
815	Josephine	Sandstone and shale	Good	Moderate	35-70	3	Medium	Medium
						4	High to medium	Medium
						5	High to very high	Medium
815V	Josephine (variant)	Sandstone	Good	High	30-35	3,4	Questionable	Medium
816	Sites	Sandstone and shale	Good	Moderate	35-50	3	Medium	Medium
						4	Medium to high	Medium
						5	High	Medium
819	Tatu	Sandstone	Good	Moderate	45-55	3,4	Medium	Low
820	Sheetiron	Schistose sedimentary rock	Good to excessive	Moderate	45-55	2,3	Medium to low	Low
						4	High to medium	Low to medium

Footnotes at end of table.

SOILS NORMALLY ASSOCIATED WITH GRASS AND OAK -- Orange color on map

Soil series symbol	Soil series name	Parent material	General drainage	Erosion hazard	Mean annual precipitation	Soil depth & other phases	Estimated suitabilities for	
							Timber production	Extensive range use
731	Climax	Basic igneous rock	Good	Low	30-40	2,3,4	Unsuited	High
732	Montara	Serpentine	Good to excessive	Moderate	30-45	1,2,2R	Unsuited	Low
745	Guenoc	Basaltic rock	Good to excessive	Moderate to high	25-35	2,2R, 3,3R	Unsuited	Medium to low
748	Sobrante	Metamorphosed basaltic rock	Good	Moderate	25-35	2,3	Unsuited	Medium
752	Yorkville	Metamorphic basic rocks	Imperfect	Moderate	30-55	2,3	Unsuited	Medium to high
832	Los Osos	Sandstone and shale	Good	Moderate	25-35	3,5	Unsuited	High
841	Glenhaven	Metamorphic sedimentary rock	Good	Moderate	25-35	2,3	Unsuited	Medium
847	Laughlin	Sandstone and shale	Good	Moderate	25-50	2,3,4	Unsuited	Medium
847g	Laughlin (conglomerate)	Conglomerate	Good to excessive	Moderate to high	30-35	4	Unsuited	Medium
847V	Laughlin (variant)	Sandstone and shale	Good	Moderate	30-35	5	Unsuited	Medium to high
849	Tyson	Sandstone and shale	Good	Moderate	50-55	3	Questionable	Medium
850	Sutherlin	Sandstone and shale	Imperfect	Moderate	30-40	3,4	Unsuited	Medium
850V	Sutherlin (variant)	Shale and sandstone and basaltic float rocks	Imperfect	Moderate	30-40	2,3	Unsuited	Medium
947	Benmore	Weakly consolidated conglomerate	Good	Moderate	30-35	3	Unsuited	Medium
947V	Benmore (variant)	Soft shale	Good	Moderate	30-35	3,4	Unsuited	Medium to high
948	Phipps	Weakly consolidated conglomerate	Good	Moderate to high	25-35	2,3	Unsuited	Medium to low
74X	--	--	Good	Moderate	25	3	Unsuited	Low

SOILS NORMALLY ASSOCIATED WITH CHAPARRAL AND MINOR CONIFERS (CYPRESS AND KNOBCONE PINE) -- Brown color on map

Soil series symbol	Soil series name	Parent material	General drainage	Erosion hazard	Mean annual precipitation	Soil depth & other phases	Estimated suitabilities for: Timber production	Estimated suitabilities for: Extensive range use
744	Konokti	Basaltic and andesitic rock	Good to excessive	High to Moderate	25-45	1,1R,2R 2,3,3R	Unsuited Unsuited	Very low Low to medium
771	Henneke	Serpentine rock	Good to excessive	Moderate	25-50	1,1R,2	Unsuited	Very low
774	Hesse	Obsidian and related volcanic rock	Good to excessive	Moderate	25-45	2,3	Unsuited	Low
775	Kidd	Rhyolitic rock	Excessive	High	35-70	1,2	Unsuited	Very low
779	Stonyford	Basaltic rock	Excessive	Moderate to high	35-50	1,2	Unsuited	Low to very low
7118	Boomer (eroded)	Basic igneous rock	Excessive	High	50-55	2E	Unsuited	Low to very low
815	Josephine (eroded)	Sandstone and shale	Excessive	High	40-50	2E	Unsuited	Low to very low
819	Tatu (eroded)	Sandstone	Excessive	High	50-55	2E	Unsuited	Low to very low
820	Sheetiron (eroded)	Schistose sedimentary rock	Excessive	High	50-55	1E,2E	Unsuited	Very low
846	Seigler	Sandstone and shale	Good	High	30-45	2	Unsuited	Low to medium
871	Los Gatos	Sandstone and shale	Good to excessive	Moderate to high	25-60	1,1R,2	Unsuited	Low to very low
871g	Los Gatos (conglomerate)	Conglomerate	Good to excessive	Moderate to high	30-40	2	Unsuited	Low to very low
872	Maymen	Sandstone and shale	Excessive	High	25-60	1,2	Unsuited	Very low
872g	Maymen (conglomerate)	Conglomerate	Excessive	High	30-40	1	Unsuited	Very low
972	Soper	Weakly consolidated conglomerate	Excessive	High	30-35	1,2	Unsuited	Very low to low
973	Pluth	Volcanic ash and cinders	Excessive	Moderate	25-40	2,3,4	Unsuited	Low
74Y	--	Pumice	Good to excessive	Moderate to high	25-45	2,3	Unsuited	Low
87Y	--	Sedimentary and meta-sedimentary rock	Good to excessive	Moderate to high	50	2,3	Unsuited	Low to very low

1/ The different soils are shown on the map by fractional symbols, e.g. $\frac{815}{4}$, $\frac{799}{3R}$, and $\frac{847g}{3}$. Miscellaneous land types are shown by the symbol 700 followed by 2 letters in parenthesis, e.g. 700(CK).

2/ The soil series symbol is shown on the map as a three (or four) digit numerator of the fractional symbol. The symbol V following a series symbol indicates a soil series variant. These are soils of limited extent which are distinctive, but closely related to, and similar to the series. The symbol g following a series symbol indicates a conglomerate parent material phase of the series. Soils of limited extent which are distinctly different from recognized soil series are symbolized by a letter replacing the third digit in the numerator of the fractional symbol, e.g. $\frac{74Y}{3}$.

3/ The rock material from which the soil was formed.

4/ General drainage refers to the rate and extent of removal of water from the soil, either by runoff or by percolation. Relative terms used are: Excessive, good (well drained), imperfect, and poor.

5/ Erosion hazard refers to the probable susceptibility of a soil to erosion after material disturbance of protective vegetative cover. Relative terms used are: Slight, moderate, high, and very high.

6/ Mean annual precipitation in inches based on isohyetal map prepared in 1941 by U. S. Army Engineers. The figures show the predominant rather than the absolute range.

7/ Soil phase (except for parent material differences) is designated by the symbols in the denominator of the fractional symbol.

Depth class of soil is designated by a number symbol:

Depth class symbol	Depth in feet	Depth class name
1	Less than 1	Very shallow
2	From 1 to 2	Shallow
3	From 2 to 3	Moderately shallow
4	From 3 to 4	Moderately deep
5	More than 4	Deep

Letters, if present, designate other phases as follows:

Phase symbol	Soil phase
E	Severe erosion
R	10 to 50% surface rock
S	Abnormal amount of coarse fragments (gravel, cobbles, stones) in the soil

8/ Estimated suitability for timber production is based on predominant site index determinations in relation to soil and climatic characteristics. Suitability is not necessarily based on nor indicative of existing vegetation in an area at the time of mapping. Relative terms used on a statewide basis are:

Suitability term	Ponderosa pine* site index	Douglas-fir** site index
Very high	200	170
High	175	140
Medium	150	110
Low	75, 100, 125	80

Questionable = conclusive evidence of suitability for growth of commercial stands of timber is lacking.
Unsuited = Nontimberland.

* Height in feet of dominant trees at 300 years.
** Height in feet of dominant and codominant trees at 100 years.

9/ Estimated suitability for extensive range use is based on observations of natural forage production and use experiences over wide areas in relation to soil and climatic characteristics. Estimates apply to open areas, either natural or cleared, under extensive management (without seeding or fertilizing) and in average condition of herbaceous cover relative to kind of soil. Consideration is also given to such factors as rockiness, topography, and erosion hazard. Suitability is not necessarily based on nor indicative of existing vegetation in an area at the time of mapping. The estimates of suitability should not be interpreted as necessarily applying to suitability of soils for forage production under more intensive management involving seeding, fertilizing, or irrigation. Relative terms used on a statewide basis are: Very high, High, Medium, Low, and Very low. The medium class is based on the average forage production and carrying capacity on the predominant soils of the woodland-annual grass type range in the foothills of the Sierra Nevada and other similar areas in the state.

STATE OF CALIFORNIA—DEPARTMENT OF NATURAL RESOURCES—DIVISION OF FORESTRY
IN COOPERATION WITH
UNIVERSITY OF CALIFORNIA
AND
U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, CALIFORNIA FOREST
AND RANGE EXPERIMENT STATION

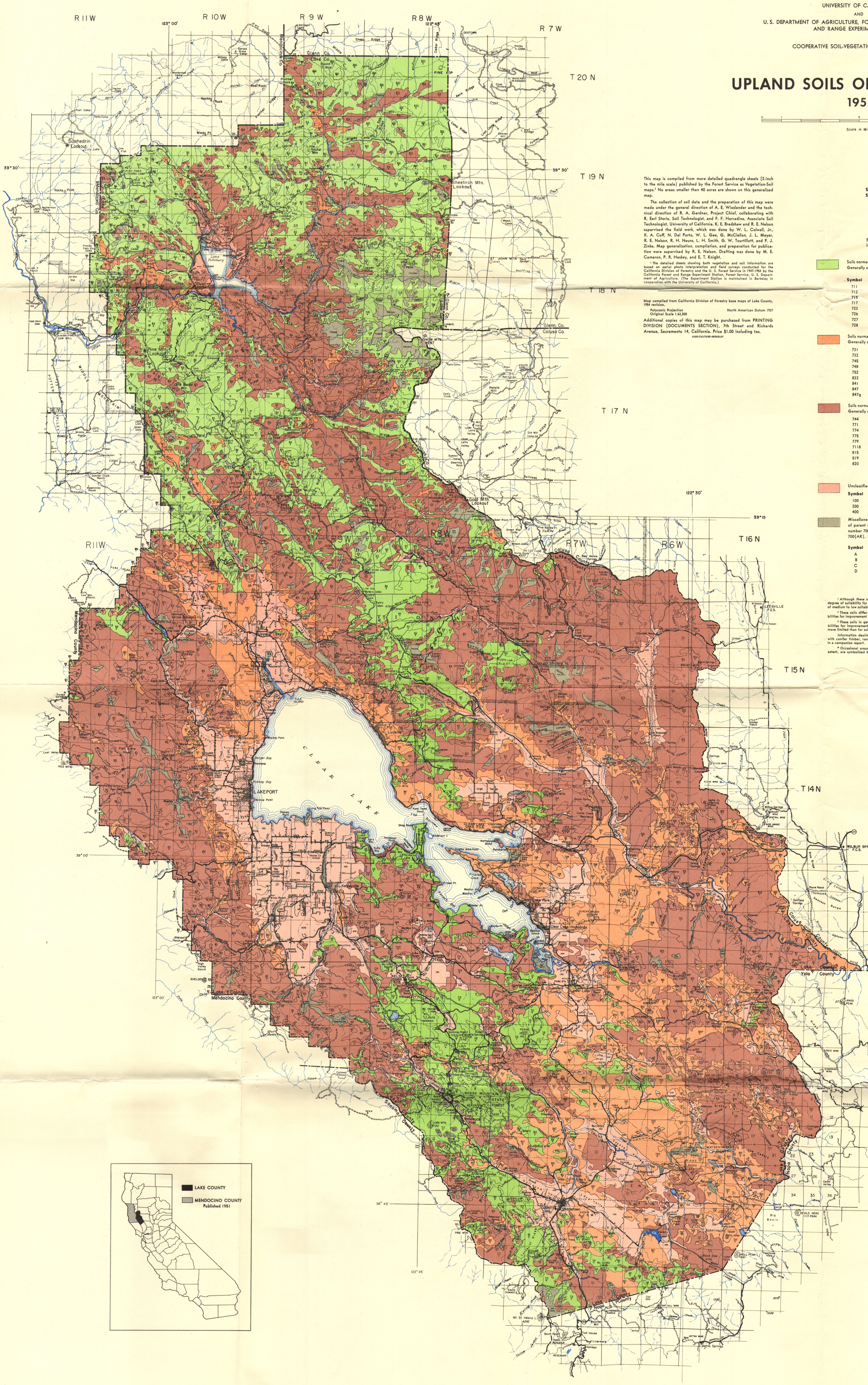
COOPERATIVE SOIL-VEGETATION SURVEY PROJECT

UPLAND SOILS OF LAKE COUNTY

1955

0 1 5 10

Scale in Miles



This map is compiled from more detailed quadrangle sheets (2-inch to the mile scale) published by the Forest Service as Vegetation-Soil maps.[1] No areas smaller than 40 acres are shown on this generalized map.

The collection of soil data and the preparation of this map were made under the general direction of A. E. Wieslander and the technical direction of R. A. Gardner, Project Chief, collaborating with R. Earl Storie, Soil Technologist, and F. F. Harradine, Associate Soil Technologist, University of California. K. E. Bradshaw and R. E. Nelson supervised the field work, which was done by W. L. Colwell, Jr., K. A. Cuff, N. Dal Porto, W. L. Gee, G. McClellan, J. L. Meyer, R. E. Nelson, R. H. Neuns, L. H. Smith, G. W. Tourtillott, and P. J. Zinke. Map generalization, compilation, and preparation for publication were supervised by R. E. Nelson. Drafting was done by M. E. Cameron, P. R. Haskey, and E. T. Knight.

[1] The detailed sheets showing both vegetation and soil information are based on aerial photo interpretation and field surveys conducted for the California Division of Forestry and the U. S. Forest Service in 1947-1954 by the California Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture. (The Experiment Station is maintained in Berkeley in cooperation with the University of California.)

Map compiled from California Division of Forestry base maps of Lake County, 1954 revision.

Polyconic Projection
Original Scale 1:62,500
North American Datum 1927

Additional copies of this map may be purchased from PRINTING DIVISION (DOCUMENTS SECTION), 7th Street and Richards Avenue, Sacramento 14, California. Price $1.00 including tax.

AGRICULTURE-BERKELEY

LEGEND

LANDS CLASSIFIED AS TO SOIL SERIES

Soil Series designated by numerator of fraction: $\frac{744}{3}$
Soil Depth Class designated by denominator of fraction:

Symbol	Depth Class	Depth, feet
1	Very shallow	less than 1
2	Shallow	from 1 to 2
3	Moderately shallow	from 2 to 3
4	Moderately deep	from 3 to 4
5	Deep	more than 4

Eroded Phase, Rocky Phase, and Coarse Fragment Phase designated by the letters E, R, and S respectively in the denominator of the fraction: $\frac{744}{2R}$

🟩 Soils normally associated with conifer timber (Douglas-fir, pine, and fir):
Generally suitable for conifer timber production.[1]

Symbol	Soil Series Name	Depth Class and Phase	Symbol	Soil Series Name	Depth Class and Phase
711	Aiken	4, 5	799	Hohmann	3, 3R, 3S, 4
712	Butte	3, 4, 5	7118	Boomer	3, 4
715	Salminas	3, 4, 4R, 5	812	Hugo	3, 4, 5
717	Olympic	5	815	Josephine	3, 4, 5
723	Comptche	4	815V	Josephine (variant)	3, 4
726	Dubakella	2, 3	816	Sites	3, 4, 5
727	Glenview	3, 4	819	Tatu	3, 4
728	Neuns	3, 4	820	Sheetiron	2, 3, 4

🟧 Soils normally associated with grass and oak:
Generally suitable for range forage but generally not suitable for conifer timber production.[2]

731	Climax	2, 3, 4	847V	Laughlin (variant)	5
732	Montara	1, 2, 2R	849	Tyson	3
745	Guenoc	2, 2R, 3, 3R	850	Sutherlin	3, 4
748	Sobrante	2, 3	850V	Sutherlin (variant)	2, 3
752	Yorkville	2, 3	947	Benmore	3
832	Los Osos	3, 5	947V	Benmore (variant)	3, 4
841	Glenhaven	2, 3	948	Phipps	2, 3
847	Laughlin	2, 3, 4	*74X		3
847g	Laughlin (conglomerate)	4			

🟫 Soils normally associated with chaparral and minor conifers (cypress and knobcone pine):
Generally suitable for wildlife range but generally not suitable for conifer timber production.[3]

744	Konokti	1, 1R, 2, 2R, 3, 3R	846	Seigler	2
771	Henneke	1, 1R, 2	871	Los Gatos	1, 1R, 2
774	Hesse	2, 3	871g	Los Gatos (conglomerate)	2
775	Kidd	1, 2	872	Maymen	1, 2
779	Stonyford	1, 2	872g	Maymen (conglomerate)	1
7118	Gloyd (eroded)	2E	972	Soper	1, 2
815	Josephine (eroded)	2E	973	Pluth	2, 3, 4
819	Tatu (eroded)	2E	*74Y		2, 3
820	Sheetiron (eroded)	1E, 2E	*87Y		2, 3

LANDS NOT CLASSIFIED AS TO SOIL SERIES

🟥 Unclassified soils generally suitable for cultivated crops or intensive pasture use:

Symbol	Kind of Land
100	Cultivated, intensively pastured, and urban and industrial areas.
200	Bottom lands.
400	Terrace and bench lands.

▨ Miscellaneous land types generally unsuitable for timber, grass, or cultivated crops. Kind of parent rock and land type designated by pair of letters in parenthesis following the number 700.
700(AK), (BK), (BP), (BR), (CK), (CR), (CW), (DK), (DM), (DR), (DW).

Symbol	Kind of Parent Rock	Symbol	Land Type
A	Acid igneous	K	Colluvial land
B	Basic igneous	M	Marsh
C	Sedimentary	P	Mine dumps and pits
D	Mixed	R	Rock land and rock outcrop
		W	Riverwash

[1] Although these soils are generally suitable for conifer timber production, the group has a wide range as to degree of suitability for such use according to kind of soil. Where cleared of timber, soils of this group are generally of medium to low suitability for range forage under extensive management.

[2] These soils differ in degree of suitability for range forage under extensive management and also as to possibilities for improvement for forage production.

[3] These soils in general are of low or very low suitability for range forage under extensive management. Possibilities for improvement for forage production vary considerably according to kind of soil but generally are much more limited than for soils in the second group.

Information dealing with specific uses of each soil in this group, and in the preceding groups, in connection with conifer timber, range pasture, watershed management, wildlife, engineering structures, and other uses is given in a companion report.

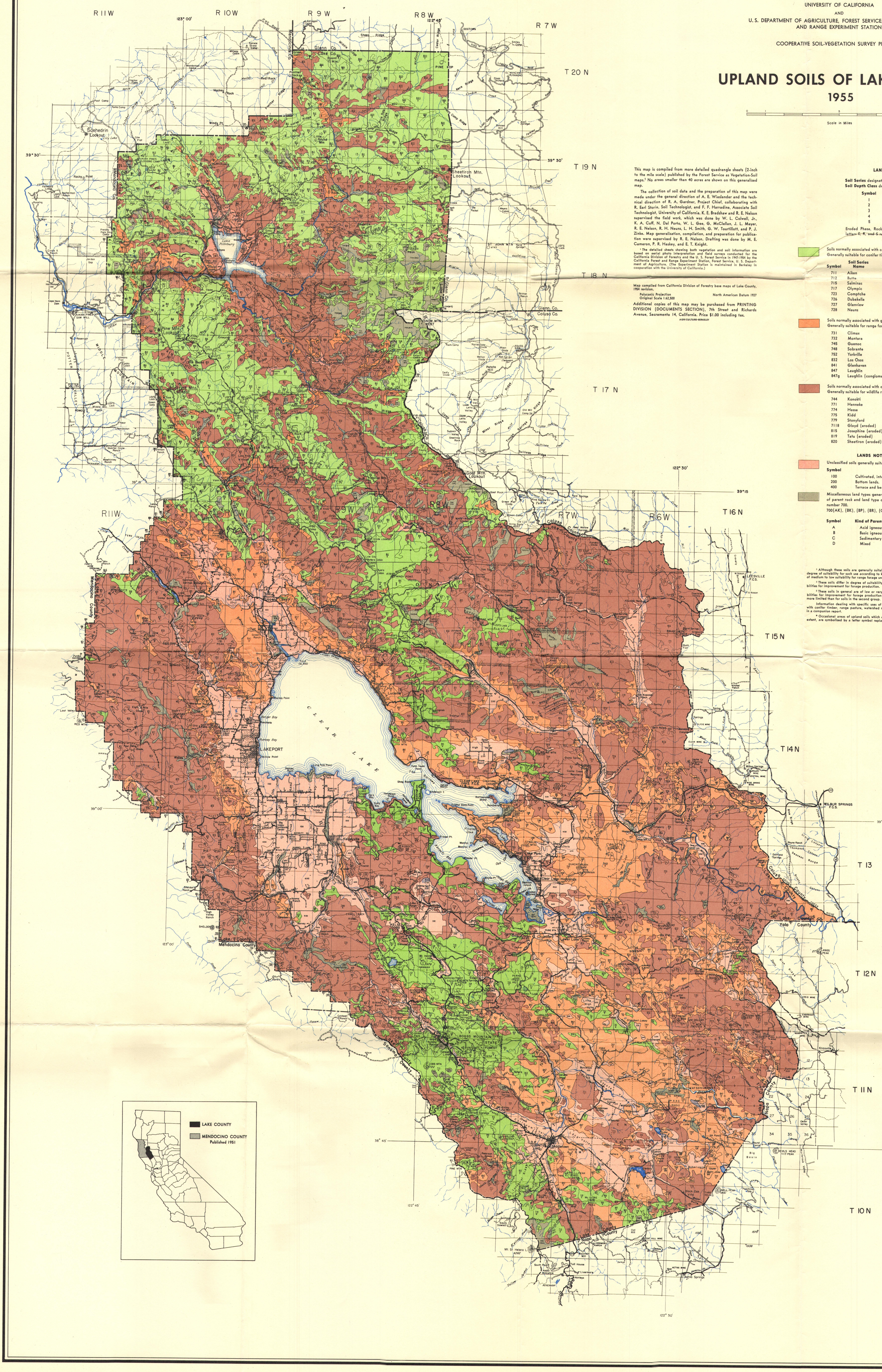
* Occasional areas of upland soils which are distinctly different from established soil series, but of very limited extent, are symbolized by a letter symbol replacing the third digit in the numerator of the fraction.

STATE OF CALIFORNIA—DEPARTMENT OF NATURAL RESOURCES—DIVISION OF FORESTRY
IN COOPERATION WITH
UNIVERSITY OF CALIFORNIA
AND
U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, CALIFORNIA FOREST
AND RANGE EXPERIMENT STATION

COOPERATIVE SOIL-VEGETATION SURVEY PROJECT

UPLAND SOILS OF LAKE COUNTY

1955



This map is compiled from more detailed quadrangle sheets (2-inch to the mile scale) published by the Forest Service as Vegetation-Soil maps.[1] No areas smaller than 40 acres are shown on this generalized map.

The collection of soil data and the preparation of this map were made under the general direction of A. E. Wieslander and the technical direction of R. A. Gardner, Project Chief, collaborating with R. Earl Storie, Soil Technologist, and F. F. Harradine, Associate Soil Technologist, University of California. K. E. Bradshaw and R. E. Nelson supervised the field work, which was done by W. L. Colwell, Jr., K. A. Cuff, N. Dal Porto, W. L. Gee, G. McClellan, J. L. Meyer, R. E. Nelson, R. H. Neuns, L. H. Smith, G. W. Tourtillott, and P. J. Zinke. Map generalization, compilation, and preparation for publication were supervised by R. E. Nelson. Drafting was done by M. E. Cameron, P. R. Haskey, and E. T. Knight.

[1] The detailed sheets showing both vegetation and soil information are based on aerial photo interpretation and field surveys conducted for the California Division of Forestry and the U. S. Forest Service in 1947-1954 by the California Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture. (The Experiment Station is maintained in Berkeley in cooperation with the University of California.)

Map compiled from California Division of Forestry base maps of Lake County, 1954 revision.

Polyconic Projection
Original Scale 1:62,500
North American Datum 1927

Additional copies of this map may be purchased from PRINTING DIVISION (DOCUMENTS SECTION), 7th Street and Richards Avenue, Sacramento 14, California. Price $1.00 including tax.

AGRICULTURE-BERKELEY

LEGEND

LANDS CLASSIFIED AS TO SOIL SERIES

Soil Series designated by numerator of fraction: $\frac{744}{3}$
Soil Depth Class designated by denominator of fraction:

Symbol	Depth Class	Depth, feet
1	Very shallow	less than 1
2	Shallow	from 1 to 2
3	Moderately shallow	from 2 to 3
4	Moderately deep	from 3 to 4
5	Deep	more than 4

Eroded Phase, Rocky Phase, and Coarse Fragment Phase designated by the letters E, R, and S respectively in the denominator of the fraction: $\frac{744}{2R}$

🟩 Soils normally associated with conifer timber (Douglas-fir, pine, and fir):
Generally suitable for conifer timber production.[1]

Symbol	Soil Series Name	Depth Class and Phase	Symbol	Soil Series Name	Depth Class and Phase
711	Aiken	4, 5	799	Hohmann	3, 3R, 3S, 4
712	Butte	3, 4, 5	7118	Boomer	3, 4
715	Salminas	3, 4, 4R, 5	812	Hugo	3, 4, 5
717	Olympic	5	815	Josephine	3, 4, 5
723	Comptche	4	815V	Josephine (variant)	3, 4
726	Dubakella	2, 3	816	Sites	3, 4, 5
727	Glenview	3, 4	819	Tatu	3, 4
728	Neuns	3, 4	820	Sheetiron	2, 3, 4

🟧 Soils normally associated with grass and oak:
Generally suitable for range forage but generally not suitable for conifer timber production.[2]

Symbol	Soil Series Name	Depth Class and Phase	Symbol	Soil Series Name	Depth Class and Phase
731	Climax	2, 3, 4	847V	Laughlin (variant)	5
732	Montara	1, 2, 2R	849	Tyson	3
745	Guenoc	2, 2R, 3, 3R	850	Sutherlin	3, 4
748	Sobrante	2, 3	850V	Sutherlin (variant)	2, 3
752	Yorkville	2, 3	947	Benmore	3
832	Los Osos	3, 5	947V	Benmore (variant)	3, 4
841	Glenhaven	2, 3	948	Phipps	2, 3
847	Laughlin	2, 3, 4	*74X		3
847g	Laughlin (conglomerate)	4			

🟥 Soils normally associated with chaparral and minor conifers (cypress and knobcone pine):
Generally suitable for wildlife range but generally not suitable for conifer timber production.[3]

Symbol	Soil Series Name	Depth Class and Phase	Symbol	Soil Series Name	Depth Class and Phase
744	Konokti	1, 1R, 2, 2R, 3, 3R	846	Seigler	2
771	Henneke	1, 1R, 2	871	Los Gatos	1, 1R, 2
774	Hesse	2, 3	871g	Los Gatos (conglomerate)	2
775	Kidd	1, 2	872	Maymen	1, 2
779	Stonyford	1, 2	872g	Maymen (conglomerate)	1
7118	Gloyd (eroded)	2E	972	Soper	1, 2
815	Josephine (eroded)	2E	973	Pluth	2, 3, 4
819	Tatu (eroded)	2E	*74Y		2, 3
820	Sheetiron (eroded)	1E, 2E	*87Y		2, 3

LANDS NOT CLASSIFIED AS TO SOIL SERIES

▨ Unclassified soils generally suitable for cultivated crops or intensive pasture use:

Symbol	Kind of Land
100	Cultivated, intensively pastured, and urban and industrial areas.
200	Bottom lands.
400	Terrace and bench lands.

▨ Miscellaneous land types generally unsuitable for timber, grass, or cultivated crops. Kind of parent rock and land type designated by pair of letters in parenthesis following the number 700.
700(AK), (BK), (BP), (BR), (CK), (CR), (CW), (DK), (DM), (DR), (DW).

Symbol	Kind of Parent Rock	Symbol	Land Type
A	Acid igneous	K	Colluvial land
B	Basic igneous	M	Marsh
C	Sedimentary	P	Mine dumps and pits
D	Mixed	R	Rock land and rock outcrop
		W	Riverwash

---

[1] Although these soils are generally suitable for conifer timber production, the group has a wide range as to degree of suitability for such use according to kind of soil. Where cleared of timber, soils of this group are generally of medium to low suitability for range forage under extensive management.

[2] These soils differ in degree of suitability for range forage under extensive management and also as to possibilities for improvement for forage production.

[3] These soils in general are of low or very low suitability for range forage under extensive management. Possibilities for improvement for forage production vary considerably according to kind of soil but generally are much more limited than for soils in the second group.

Information dealing with specific uses of each soil in this group, and in the preceding groups, in connection with conifer timber, range pasture, watershed management, wildlife, engineering structures, and other uses is given in a companion report.

* Occasional areas of upland soils which are distinctly different from established soil series, but of very limited extent, are symbolized by a letter symbol replacing the third digit in the numerator of the fraction.